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CHEMICAL & ENGINEERING

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Farming in Europe

Changing policies bring hard times to fertilizer makers

Page 7

CHEMICAL & ENGINEERING NEWS

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MARCH 14, 1988

News of the Week

■ **New thallium-containing copper oxide becomes completely superconducting at a record 125 K.** **Page 4**

■ **Amendments to the Clean Air Act, if enacted, would increase pollution expenses for industry at least $32 billion a year, says Business Roundtable.** **Page 5**

■ **Koppers Co., a Pittsburgh-based construction materials and chemicals producer, is resisting takeover by British construction firm Beazer.** **Page 5**

■ **Former refuseniks, recently allowed to emigrate, gathered in New York City to thank U.S. scientists for their efforts and to urge backing for scientists still in the U.S.S.R.** **Page 6**

■ **This Thursday India's high court will rule on whether Union Carbide should pay $270 million in interim compensation to victims of the methyl isocyanate leak at its Bhopal plant.** **Page 6**

Cover: "The Cornfield," painted in 1826 by John Constable. Reproduced with permission of the National Gallery, London

Letters 2
Editor's Page 3

Concentrates
Business 13
Government 18
Science/Technology 21

The Departments
ACS Comment 27
People 43
Newscripts 44

Business

Quantum Chemical, new name of National Distillers & Chemical, marks change to petrochemicals and energy firm. **Page 15**

Government

Impact on U.S. firms of lax intellectual property laws in foreign countries is detailed in new survey, which will be used by Administration to push for stronger protection. **Page 19**

Science

Effort to map the entire human genome is backed by the National Research Council, which recommends that a 15-year, $200-million-a-year project to accomplish that goal begin immediately. **Page 22**

National Academy of Engineering elects 85 engineers to academy membership, including several in chemically related areas. **Page 26**

ACS News

ACS has initiated a multimillion-dollar fund-raising drive to expand several activities of the society. **Page 28**

News Focus

In light of recent stagnation in the fertilizer industry, European manufacturers are especially concerned about impending revisions in European Community agricultural policy that might reduce fertilizer demand. **Page 7**

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LETTERS

Education in chemistry

SIR: The letter by Rustum Roy (C&EN, Jan. 18, page 3) prompts us to respond to certain issues and concepts relating to both education and funding.

First, we find to link the current "disastrous national debt" in any way with the meager funds expended by the National Science Foundation makes no sense.

Second, on the issue of graduate education in chemistry, we feel that any move to an applied science basis can be accommodated only to a limited degree. The basic level of training at our undergraduate institutions leaves much of the basics of chemistry still to be learned, and much of the value of our present programs is aimed in that direction through course work, examinations, tutorials, and the teaching of basic experimental techniques. Compared with many other countries, our B.S. majors have taken little chemistry and need the extra curriculum. This difference originates in part from the shorter training period dedicated to chemistry in the U.S. compared with some countries that Roy praises. Is it not also true that some of the research described by Roy as "esoteric" and "inward looking" could be equally well described as "concerned with establishing new fundamentals?"

Third, although we agree that we do need to teach more courses at the graduate level that are relevant to industry and are interfacial with other disciplines, we feel it is unreasonable to expect that our graduate programs could or should be aimed at totally applied problems. Science as a whole grows and feeds on new discoveries, and if we could predict where, when, and how these discoveries could be made, industrial research would surely have solved all that is needed to be known. It was the discovery of ferrocene, for example, that indirectly led to the use of chromocene supported on silica as the Union Carbide catalyst for the polymerization of ethylene. Could this have been predicted? And did the physicist predict that so-called 1-2-3 oxides would be high-temperature superconductors?

If the National Science Foundation does not continue to fund basic chemistry, this country will lose its leading role in chemistry and essentially lose its graduate programs in chemistry. Only from a strong and broad background can chemists respond to current issues of national interest. The maturity of molecular design and electronic structure places the chemist in a prime position to contribute to the rational design of new materials in the same way that a sound knowledge of physical organic chemistry coupled with an arsenal of synthetic methodologies allows for success in the area of the synthesis of natural products and new pharmaceuticals. We suggest that the currently structured graduate chemical education is successful if it is viewed as an apprentice system that teaches problem solving via one specific scientific project. Subsequent self-study on topics new to the fresh Ph.D. is inevitable during the course of a 30-plus-year scientific career. Versatility and flexibility in job responsibilities are key traits sought in the industrial hiring process.

With the need thus established for such versatility, the question now moves to Roy's reluctance to "fund more chemists out of the materials pot." Given the need to deal constructively with the current chemistry faculty population, we suggest that federal incentives together with the "Kennedy-esque call" (to serve one's country) are perhaps quite effective ways to influence the future research and teaching creativity of our present teachers.

Kenneth G. Caulton
Malcolm H. Chisholm
Indiana University

Contributions to glossary

SIR: The IUPAC Commission on Physical Organic Chemistry (III.2) is working on a revised and extended edition of the "Glossary," edited by the late Victor Gold and published in *Pure & Applied Chemistry* [**55**, 1281 (1983)]. It is desirable that this revision takes into consideration as much as possible the opinion of the scientific community, and all scientists interested in this project are invited to contribute.

Comments and criticism on the first edition of the "Glossary," suggestions for the revision as well as copies of the correspondence exchanged with Victor Gold on this matter should be mailed to the chairman of Commission III.2, Paul Müller, Department of Organic Chemistry, University of Geneva, 30, quai Ernest Ansermet, CH-1221 Geneva 4, Switzerland.

P. Müller
President, IUPAC Commission on Physical Organic Chemistry

ers think they are more stable than the 1-2-3 compounds, which degrade on standing in moist air.

The newest superconductors also may turn out to be easier to process into useful shapes. But precautions will be necessary because thallium is toxic: Its sulfide, for instance, is used as rat poison.

The recent upheavals in superconductivity research caused by the discovery of the bismuth and thallium materials have stunned and exhausted researchers, Engler says. But "we're all happy," he adds, because "it has reminded us that this field is still full of surprises." The rise in transition temperature, coming after many unsubstantiated reports of superconductivity at much higher temperatures, also has rekindled scientists' optimism that room-temperature superconductivity is achievable, he says.

Ron Dagani, Washington

Business group blasts changes in clean air bill

Business Roundtable has released a detailed analysis of the costs that would be imposed on industry by amendments to the Clean Air Act currently being considered by the Senate. If enacted, the changes would increase pollution control expenses for industry at least $32 billion a year above present costs and eliminate at least 300,000 to 600,000 U.S. jobs, according to the analysis.

The numbers are higher than, but within the same range as, estimates by the Congressional Research Service (up to $28 billion) and the Environmental Protection Agency (about $24 billion).

"This bill would be the most expensive environmental legislation ever adopted and the least cost-effective," says David M. Roderick, chairman of Business Roundtable's environmental task force and of USX Corp. (Business Roundtable is an association of some 200 major corporation executives that acts on public issues.) "If it were enacted, total annual environmental control costs would exceed $100 billion, about 2.5% of the gross national product." Furthermore, notes Roderick, the bill would add up to 8.6% to the cost of many industrial products, harming U.S. competitiveness in international trade.

The bill, S. 1894, was introduced last year by Sen. George J. Mitchell (D.-Me.) and reported for floor action by the Senate Committee on Environment & Public Works last November. Titled the "Clean Air Standards Attainment Act of 1987," the bill would put areas into compliance that do not meet present standards, and provides for acid rain control, new fuel and emissions standards, and more rigorous control of industrial releases of toxic chemicals into the air. Business Roundtable believes the bill targets unachievable air quality goals.

The association's analysis was prepared by the consulting firm R. M. Dowd & Co. of Washington D.C. Only 21 of the 43 provisions in the bill were amenable to cost estimates. It is impossible to quantify expenses such as increased costs of automobiles to consumers, the report concludes, because technology to meet the proposed standards doesn't exist yet.

Estimated additional costs for the chemical industry fall into three areas. Emissions of nitrogen oxides and volatile organic compounds from process plants would have to be cut to attain ozone standards. Emissions of sulfur dioxide must be controlled to meet the acid rain provisions. And a variety of controls would be needed to reduce releases, both controlled and accidental, of a class of hazardous chemicals. The report estimates costs to the chemical industry of $2 billion to $9.5 billion a year.

David Hanson, Washington

Clean air changes would greatly raise industry costs

$ Millions	1986 output value	Costs due to S. 1894	% of output value
Aluminum production	$ 2,000	$ 134	6.7%
Chemicals	193,453	4337	2.2
Copper & lead smelting	1,460	128	8.8
Food	310,584	678	0.2
Iron & steel	33,000	818	2.5
Motor vehicle production[a]	179,195	1446	0.8
Petroleum production	86,639	1029	1.2
Petroleum refining & sales	141,511	9096	6.4
Pulp & paper	75,423	1609	2.1
Rubber	21,224	566	2.7
Textiles	51,282	636	1.2

Note: Comprises cost estimates only for 18 of the 43 provisions in the proposed law. a Includes stationary sources only.
Source: Business Roundtable

Koppers under siege from British builder

In one of the latest moves in the corporate takeover game, Koppers Co., Pittsburgh-based construction materials and chemicals producer, has received a takeover bid from investment group BNS Inc., led by British construction firm Beazer, for $45 per share, or $1.3 billion. Although Koppers has not yet officially commented on the proposal, it is evident that the company's management will resist the offer at that price.

In a letter to Koppers chairman Charles R. Pullin made public last week, Brian C. Beazer, chairman and chief executive officer of the British firm, pointed out that he had attempted to arrange meetings with Pullin on three separate occasions. Beazer also stated in the letter, "It remains our desire to enter into a negotiated transaction and to determine, among other things, whether a higher price is, or is not, warranted."

Wall Street, in its own way, is helping Koppers resist the offer by keeping the company's stock price high. And Beazer's statement that he may be willing to raise the price is adding to Wall Street's resolve. Following the offer by Beazer, the price of Koppers' stock soared more than $6.00 per share. Since that time it has held in the $52 to $53½ range, about 15% more than the Beazer offer price. Obviously, arbitrageurs are expecting either an increase in the offer price from Beazer or a competing offer from another company.

The construction materials side of Koppers probably interests Beazer most. The British company has been working to build a fully integrated construction firm, acquiring in the

Changes in European Farm Policies Trouble Fertilizer Industry

In the face of growing payments to farmers and increasing food surpluses, the European Community is looking at ways to control these problems—but proposed solutions could reduce fertilizer use

Patricia L. Layman, C&EN London

European fertilizer makers have long memories. They remember when, shortly after World War II, European governments exhorted their farmers to "Dig for Britain" or for France or Belgium or wherever else, uprooting trees or hedges, if needed, to raise more and more food and grain to feed a war-wracked populace. Fertilizers were a respected partner in that effort.

They also recall specific instances of government policy determining courses of action that would affect their industry. For example, as little as 10 years ago, the European Community's agriculture mavens encouraged farmers to grow rapeseed as a good cash crop that would help cut seed-oil imports. It also happens to be a heavy feeder, requiring significant use of fertilizer.

But how things have changed. The community, saddled nearly to the point of bankruptcy with steadily mounting payments to farmers and faced with food surpluses that have become an embarrassment, is trying to cut back. As EC's policies, and those of its member nations, change, there undoubtedly will be a long-lasting impact on the fertilizer industry. Unfortunately, it will be an impact not needed: Fertilizer makers are already facing long-term prospects of stagnation at best, with shrinkage more likely. Exports, always a significant part of the business, are decreasing, and imports are increasing, competing for a bigger share of a shrinking pie. All this makes fertilizer a victim of its own success.

The crux of EC's problem is its Common Agricultural Policy, a set of complex price supports that has materially raised the standard of living for most of the 10 million farmers in the community. However, the policy features few controls, and farmers have continued to increase production to increase their support benefits beyond the actual needs of Western Europe.

Lonza photo

Agricultural fields near Swiss village of Hermiswil

By the end of this month, officials of the European Commission—the administrative arm of the European Community—will begin working out new agricultural price proposals for the next marketing year. Meeting in Brussels, agriculture ministers from each member nation will begin to tackle a handful of thorny proposals to change European agriculture, including proposals on how to do it and on how it should be supported by government.

The ministers face three possibilities for change:

- A simple, market-driven philosophy. Let prices

Cadmium and nitrates from fertilizers cause environmental concerns

There is growing awareness throughout Western Europe about the impact fertilizers have on the environment. One concern relates to cadmium, a natural component in phosphate rock. Another centers on the nitrate content of drinking water. Some countries are further along than others in formulating laws on permissible levels of cadmium and nitrate release. And moves have been under way in Brussels toward drawing up standards for the 12 European Community member countries.

Cadmium is highly toxic, causing death of some forms of water life at concentrations of 0.1 ppm or less. It tends to accumulate in organisms over a period of time because it isn't readily eliminated.

Awareness of the health risks associated with cadmium isn't new. The element has been linked to the death and considerable physical discomfort of Japanese who ate contaminated rice grown in paddies irrigated with industrial wastewater (C&EN, Aug. 10, 1970, page 15). It is on the black list of substances cited in the framework convention for the protection of the Mediterranean Sea against pollution sponsored by the United Nations Environment Program (C&EN, Feb. 28, 1977, page 17). And the World Health Organization (WHO) has recommended that the provisional weekly intake by humans shouldn't exceed 400 to 500 μg.

Fertilizers aren't the only source of cadmium released to the environment. Cadmium is also a component of batteries and tires, pigments and stabilizers, metal platings, and the powders in fluorescent light bulbs. It also occurs in gaseous effluents from incineration plants and coal-fired power stations.

In fertilizers, the amount of cadmium varies greatly from one source of phosphate supply to another. Deposits in Finland, the Soviet Union, and South Africa are lowest in cadmium, typically 3 mg per kg of the phosphate (P_2O_5) content, or even less. Jordanian rock has from 15 to 30 mg per kg of P_2O_5. Cadmium in U.S. phosphate rock varies from about 20 to 120 mg per kg of P_2O_5. Comparable levels for other countries where the rock occurs are 40 to 120 mg per kg of P_2O_5 in Morocco, 50 to 100 in Israel, 140 to 170 in Togo, and 220 to 280 in Senegal.

The rock's cadmium ends up in phosphoric acid and in the active ingredients of fertilizers made from it. Diammonium phosphate produced in the U.S., for example, can have from 20 to 80 mg per kg of P_2O_5, that supplied by Tunisia 75 to 100. In the case of triple superphosphate, material from Morocco and Tunisia may contain as much as 120 mg per kg of P_2O_5.

Denmark, Finland, the Netherlands, Sweden, and Switzerland are in the forefront of setting limits on the amount of released cadmium tolerated. Denmark aims to reduce the cadmium limit in fertilizers in stages, from 200 ppm this year to 50 ppm in 1998. Finland has a limit of 30 ppm of cadmium in fertilizer.

Authorities in the Netherlands are concerned because the mean weekly cadmium intake by the population is about 175 μg, notes Wim Sprong at the Ministry of Housing, Physical Planning & Environment in The Hague. "That means that possibly too many people are above the WHO recommended limit," he points out. "One of the problems is that we don't know precisely the form of the distribution curve."

Because cadmium is fairly easily taken up by crops, it is assimilated by dairy cattle, Sprong notes. The contention is that about half of that cadmium comes from fertilizers, half from both wet and dry deposition. "Since about 60% of the waste here in Holland is incinerated, this is an important cadmium source," he says. He admits, however, that the widespread use of cadmium by industry would make a reduction in the wet and dry deposition rates "virtually uncontrollable."

His ministry is tackling the problem on two fronts. One forbids use of plastic consumer products with cadmium used in pigments and stabilizers, and of metal items plated with cadmium. The other seeks to lower the permissible level of fertilizer cadmium ultimately to 15 ppm on the P_2O_5-content basis from the present mean value of 70 to 80 ppm.

Apart from using low-cadmium phosphate rock, supplies of which aren't sufficient to meet all the fertilizer producers' needs, the as-yet unanswered question is how best to extract the cad-

fall enough, as they would for a crop in gross surplus, and farmers would then stop producing that particular crop. Politically, this is a totally unrealistic option, which even rigorous economists in the industry concede, and it has little or no chance of being adopted.

• Stabilizers on price supports, to try to cap expenditures. Supports would be at a set level, up to a fixed quantity. If farmers collectively were to go beyond that, they would receive only world prices—generally substantially lower than those supported by EC. In a way, points out one economist, stabilizers are a modified form of price reduction. But they enable EC to avoid reducing supports themselves. The high payments can continue, up to a point, to maintain high agricultural prices and incomes—politically very important in rural areas.

• Set-asides. The U.S. has practiced this policy for years—compensating farmers for taking some land out of cultivation to reduce total yields. Whether it works or whether farmers try to boost production from the remaining acreage probably is not really important per se. What is more important is that even if it does work, it doesn't solve the problem of surpluses overnight. Any such program, once adopted, must be looked upon as a long-term commitment.

EC has agreed to adopt some sort of stabilizer pricing. In addition, the commission almost certainly will impose some sort of set-aside program. It sees set-asides as part of a general scheme of "extensification," officially defined in community rules as a reduction in a farmer's output of a surplus product by at least 20% without other surplus production capacity being increased. As such it has seriously directed member governments to come up with specific proposals for set-aside programs, with the intention of reaching an agreement by the middle of this year. As an information

mium from fertilizer raw materials. Some companies are exploring calcination techniques, trapping the cadmium in the flue gases. Others are looking into use of ion-exchange resins to remove cadmium from phosphoric acid.

Although such techniques might work at bench scale or even the pilot plant level, there is some question about their technical and economic feasibility in commercial plants. Should suitable methods be devised, there will remain the problem of ultimate disposal of the cadmium. There would be a financial incentive to recover it if the current high market price for cadmium were to remain in force.

There is no doubt that cadmium removal will add to the cost of fertilizers, Sprong concedes. He thinks that a 10% or so price increase might be sufficient to pay for the added processing steps. For this reason alone, he and others believe it is important that there be a Europewide agreed limit to the permissible cadmium content of fertilizers.

Responding to the groundswell of concern, the Commission of the European Community has proposed an action program to control environmental pollution by cadmium. Last December, the EC Council of Ministers issued a resolution noting that "such control should be pursued through an integrated approach, taking into account all the various sources of cadmium pollution." Among the major elements of the strategy for cadmium control, the resolution calls for "stimulation of research and development related to the cadmium content of the raw materials used for production of phosphate fertilizers."

The EC Commission also has moved on setting recommended limits on nitrate ion content of groundwater and drinking water. Its 1985 directive, titled "Quality of Water for Human Consumption," sets a maximum admissible concentration of nitrates at 50 mg per L, down from an earlier level of 100 mg per L, with a guide level of 25 mg per L. This permissible maximum relates to every water sample analyzed, not to an average of readings.

Legislators' concerns about nitrate are twofold. One relates to a condition called methemoglobinemia, a blood disorder more usually associated with babies younger than six months. Referred to as blue baby syndrome because the skin turns blue, it is caused by the inability of blood to carry adequate quantities of oxygen when deoxygenated hemoglobin is irreversibly oxidized to methemoglobin, which cannot hold oxygen. Nitrite ions stemming from nitrates are a causative factor. Fortunately, the disease is extremely rare, and virtually nonexistent in Western Europe for the past 20 years or so.

Seemingly, a high nitrate level in ingested water alone doesn't bring it about. An accompanying bacterial infection, such as gastroenteritis, is involved, notes a just-completed detailed study of the health implications of nitrates in water. The study was made by a Europe-wide panel of experts drawn together by Brussels-based ECETOC, the European Chemical Industry Ecology & Toxicology Center.

"There is no evidence that infantile methemoglobinemia is caused by bacteriologically sound water supplies containing nitrate concentrations up to 100 mg per L," the report concludes. It adds that "98% of the European population is supplied by piped-mains water treated to remove bacteriological contamination. The remaining 2% is supplied with well water of variable quality."

The other cause of concern is the suggestion that nitrates might lead to development of stomach cancer in humans. The proposed pathway is that nitrate-derived nitrite ions interact with amines to form nitrosamines, which have been linked with the onset of cancer. This theory doesn't appear sound in light of the decline in the incidence of stomach cancer despite increasing nitrate levels. Moreover, in the case of the U.K., deaths from stomach cancer are lowest in the East Anglia region even though that region has one of the highest water nitrate levels in the country.

In light of the essential absence of health risks, the ECETOC study concludes that "Recent reductions in the acceptable upper limit for nitrate in drinking water from about 100 to about 50 mg per L [are] not justified."

Dermot O'Sullivan, London

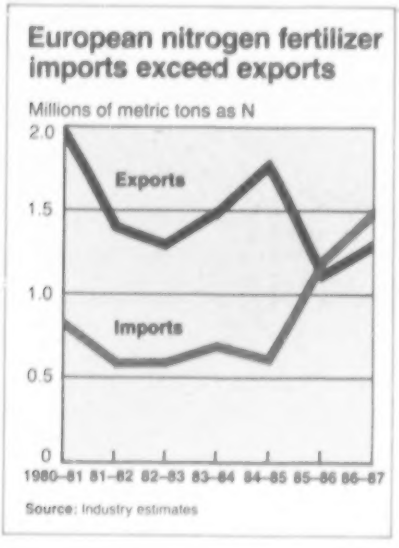
memo from Brussels put it in January. "In order to respect farmers' freedom of choice, the proposed scheme must be optional. However, in order to be effective, it must be mandatory for member states in the sense that each country will be obliged to introduce it."

The proposal has met with mixed success. In France, farmers generally support the idea, provided the set-aside land can be turned to livestock—a potential problem because some livestock are in surplus. And in West Germany, the state of Schleswig-Holstein has adopted a set-aside program already, although for only 10% of arable land.

In the U.K., the Ministry of Agriculture, Fisheries & Food last December circulated proposals for meeting the EC request to such groups as the National Farmers' Union, the Country Landowners' Association, ancillary industries such as fertilizer makers, and fringe pressure groups including Greenpeace, organic farming lobbies, and others. Comments were due on Feb. 2, the goal being to send a workable program to Brussels by June.

Comments and numbers on the ministry's proposals show where the problems will be. The U.K. proposal would offer a farmer the opportunity to set aside a minimum of 20% of his or her land. The proposed level of compensation would be $266 to $354 per hectare, or $108 to $143 per acre ($1.00 = £0.565 on March 4, 1988).

However, that level of compensation might not be enough to bring about the desired reduction. According to one industry analyst, "We know the margins producers achieve and their costs of production. Margins of the bottom 25% producers are much higher than those proposed." Costs, he calculates, are equivalent to roughly $265 per acre. If machinery running costs of $50 per acre are assumed, this indicates that the incentive needs to be about $215 per acre for the farmer to break even.



At the proposed prices, farmers would be worse off, unless they could save fixed costs (machinery and labor). A 20% reduction in area wouldn't do that in a meaningful way. A farmer can't have 20% less of a tractor, for instance. Working on the assumption that one farm worker and a tractor can handle 250 acres, a farmer would need to have a base of 1250 acres to cut one worker and one tractor. However, an average cereal enterprise has only 110 acres.

A recent survey by consultants Cambridge Farm Management found that in cereals, the major surplus concern, the most marginal production is spring barley, not wheat, and wheat is the main surplus. Moreover, spring barley as a crop is concentrated in certain parts of the country, primarily Scotland, which would lead to a concentrated, localized uptake of the scheme. That leads to another question: If barley is taken out of Scotland, what would that mean for Scottish distilleries?

Other industry observers ask about alternative uses for the set-aside land. Some suggestions have included golf courses and other similar recreational uses, but these could realistically take only a small proportion of what would be a lot of land. "The only real alternative is forestry," argues one analyst, "but unless that is subsidized, the economics are crazy. In the meantime, how are farmers to live? It'll just mean more major government subsidies." Forestry as an alternative would also mean that farmers would need a long-term commitment to a set-aside program, if only because it takes a long time for trees to grow and for farmers to recoup their costs.

With its interests set on the set-aside program, the European Commission elected not to consider the problem of the density of livestock stocking—the number of head of livestock for a given area of land. But countries in Western Europe, both inside and outside EC, have decided the subject is a fit one for consideration.

It basically is a means of controlling what one newspaper wag has dubbed the latest "mountain"—the "muck mountain"—with the concern being nitrate contamination of underground water supplies. As more and more livestock have been raised throughout the community, there has been more and more manure produced, more than needs to be spread on the farmers' own fields. The consequences involve either direct runoff into water systems or overabundant spreading on land, with subsequent leaching of nitrates into the water. This is a particular problem in the Netherlands, Denmark, Switzerland, and West Germany.

The Dutch and Danish governments and the cantonal government in Lucerne, Switzerland, have introduced laws that essentially control stocking levels: a farmer will be allowed only so many hogs, beef, or poultry for given quantities of land. If he currently has more, he will have to get rid of the excess, or, in the Swiss variation at least, come up with a contract showing that someone qualified will purchase the extra manure and take it away. The Dutch government also plans to impose a levy on surplus manure.

With competing nitrogen from organic sources and from the set-asides, what does this mean for the fertilizer industry? Says Stuart J. Challinor, senior business economist for ICI Fertilizers, "In the U.K., cereals are 50% of the nitrogen market. In theory, a 20% set-aside could mean a reduction of 10% [in nitrogen fertilizer demand]. It could be as simple as that. That wouldn't happen, though, because you would see some intensification of what's left, and some fertilizers for golf courses and forestry."

Nonetheless, even part of a 10% decline in business, combined with the reduced production that a program of price support stabilizers would lead to, would be the last thing the fertilizer industry needs. For now, it is also coping with a rather dreary long-term outlook, following hard on the heels of the beating it has taken over the past several years.

At the International Fertilizer Forum in Antwerp in November, sponsored by British Sulphur Co., Pertti Laurilla, business development executive with Finnish fertilizer producer Kemira, highlighted some of the recent trends in the industry. Nitrogen use increased until the early 1980s in Western Europe, but it has leveled off in the past couple of years. For phosphorus and potash, there has been no growth since the early 1970s, and during the past few years, "consumption has even been declining," he said.

Slightly less than 30 million metric tons per year of nitrogen-phosphorus-potassium (NPK) fertilizers, including blends, are used in Western Europe, he said—a figure that has remained practically unchanged for many years. Although consumption has remained static, significant changes have been occurring in the structure of the industry itself.

These changes were given a special boost by the industry's 1986 economic losses. William Klaassen of Dutch producer DSM told the Antwerp meeting that in 1986 fertilizer producers in Western Europe had expected difficulties and even poor results. But no one expected the actual results—aggregate losses throughout the industry of roughly $500 million.

Those conditions spurred a boom in the merger and acquisition activity that had started at the beginning of the decade. As Klaassen put it, "For some, it was a rude awakening to the basic elements of economic forces, the need to constantly improve or perish. No longer could the lame lead the blind."

Norsk Hydro—which had acquired Dutch fertilizer company NSM, the second largest in the Netherlands, in 1979, and the fertilizer division of the British pharmaceuticals company Fisons, in 1982—kept building by buying. In 1985, the Norwegian company acquired the fertilizer operations of Veba in West Germany, which it has continued to operate under the name of Ruhr-Stickstoff, the second largest producer in West Germany. And in 1986, Norsk Hydro acquired 80% of the shares of Cofaz, the second largest fertilizer producer in France, which is Europe's biggest fertilizer market.

Finnish producer Kemira had already acquired Danish fertilizer company Superfos to solidify its base in the Nordic countries. It then went straight into the major European markets by acquiring Carbochim and Sadacem, subsidiaries of Belgian producer Gechem. The acquisition gave a good push toward doubling Kemira's business in fertilizers.

ICI in the U.K. and Nitrogin Eireann Teoranta in Ireland combined interests, and ICI also consolidated its hold on Scottish Agricultural Industries, buying the remaining outstanding shares of the Scottish fertilizer company. And France's tangled agricultural industry got a bit of sorting out as various units were pulled together under the aegis of CdF Chimie.

Industry observers generally feel that there is still a bit of tidying up to do. The Spanish fertilizer industry, for example, is currently in the throes of restructuring. And there are continual reports that, in Italy, there will be talks by Fertimont (the fertilizer arm of Montedison) and Enichem to pool interests.

However, the industry now stands with a handful of major companies dominating the Western European market: Norsk Hydro, ICI, BASF, DSM, Kemira, and CdF Chimie. DSM's Klaassen reached the following conclusions: "There are not many further mergers to be expected, and all these remaining producers, without doubt, intend to stay in the fertilizer business in one way or another."

The mergers and capacity retirements have certainly helped the industry. Though not alone responsible for improved results, things have been picking up a bit. For example, in 1987, Norsk Hydro's agricultural group had operating income of $163 million ($1.00 = 6.27 Norwegian crowns on Dec. 31, 1987) on sales of $4.55 billion, compared with a loss of $87.2 million on sales of $4.51 billion in 1986. The improvement was strongest for the agricultural group's fertilizer activities, the company said.

On the other hand, when H. B. van Liemt, chairman of DSM's board of management, announced profit estimates at Christmas, he said that performance in the agricultural group was disappointing and that this would limit group profit growth for the year. Rationalizations within the agro division during 1987, he said, had had a beneficial effect, but there was still room for further improvement.

And when Denys Henderson, chief executive officer of ICI, announced the company's annual results in late February, he made a similar point. The company's fertilizer operations lost less, albeit on lower sales, than in preceding years, he said—a loss of only $7.5 million ($1.00 = £0.530 on Dec. 31, 1987), compared with a $40 million loss in 1986. Fertilizer sales were $1.6 billion, down from $1.7 billion in 1986. Despite the cut in the losses, however, he added, "We will go on hacking away at parts of that business."

One factor affecting the industry is the arrival of urea into EC from six countries at dumped prices. In October 1987, product coming from Austria, Hungary, Malaysia, Romania, the U.S., and Venezuela was the subject of a new antidumping probe by the commission (C&EN, Oct. 19, 1987, page 14). EC fertilizer makers claimed that urea from these countries quadrupled to 414,000 metric tons in just three years, an increase in the EC market share from 3.6% to 12%. Also in 1987, EC imposed antidumping duties on urea from Libya and Saudi Arabia, and set limits to the quantity coming from Czechoslovakia, East Germany, Kuwait, the Soviet Union, Yugoslavia, and Trinidad and Tobago.

The imports continue to come in. Moreover, fertilizers from other producers will continue to eat into the markets that Western European manufacturers traditionally have exported to.

As Karl-Heinz Tillmann, director for fertilizers at

Western Europe's fertilizer use overtakes that of North America

Millions of metric tons per year	1986–87*	1985–86	1984–85	1983–84
EASTERN EUROPE				
Nitrogen	16.7	16.2	15.4	15.6
Phosphate	11.2	10.7	9.8	9.6
Potassium	10.2	10.1	9.5	9.5
WESTERN EUROPE				
Nitrogen	10.6	10.3	10.1	9.9
Phosphate	4.8	4.9	5.1	5.2
Potassium	5.0	5.2	5.3	5.3
NORTH AMERICA				
Nitrogen	9.9	10.7	11.7	11.2
Phosphate	4.2	4.5	5.0	5.2
Potassium	4.7	5.0	5.4	5.6
DEVELOPING COUNTRIES				
Nitrogen	32.5	31.4	31.8	29.0
Phosphate	11.6	10.9	11.8	10.5
Potassium	4.8	4.5	4.6	3.9
TOTAL WORLD				
Nitrogen	71.2	70.0	70.5	67.1
Phosphate	33.9	33.1	34.0	32.9
Potassium	26.1	25.6	25.9	25.4

a Estimated. **Source:** West German Fertilizer Association

BASF, puts it, "New countries supplying nitrogen fertilizers are coming up, countries where energy is worth [costs] almost nothing, and with a small or no home market."

A case in point is Saudi Arabia. Late last month, Saudi officials confirmed plans to build a new world-scale, export-oriented ammonia plant at Al Jubail, using one of two options—a 500,000 metric ton-per-year plant based on off-gas feedstock, or a conventional ammonia unit of the same capacity. Saudi Arabia already has one 500,000 metric ton-per-year ammonia plant intended for use in downstream fertilizer plants being built for the National Chemical Fertilizer Co., Ibn Al-Baytar. These will include a 500,000 metric ton-per-year urea plant in the first phase, to be followed by a plant of the same size for NPK fertilizers, one roughly half that size for triple superphosphate, and a 30 metric ton-per-day plant for liquid nitrogen-phosphorus fertilizers. These plants will eventually supply the export market.

China and India remain the major import-receiving countries, despite each country's efforts to build up its own industry. But they haven't yet caught up and still need imports, as does most of densely populated East Asia. The next largest export market is Central and South America; then Africa. Africa, with a population expected to reach 1.25 billion by the year 2030, needs fertilizers the most and is least able to afford them.

With the change in trade patterns has also come changes in products. Blends of fertilizer have become increasingly important, as local or regional bulk-blenders have been able to buy ingredients freely on the spot market to mix and sell. According to Kemira's Laurilla, bulk blends now hold 10% of the West European share of the NPK market. Some individual countries show much higher proportions. In Ireland, for example, bulk blends account for 85% of the market, and in the U.K. they account for 30%. However, speaking at the Antwerp meeting, Laurilla predicted that in 10 years they will account for no more than 15% of the Western European market because of a number of adverse factors, such as uncertainties in prices of "commodity" intermediates, poorer quality of blends compared with homogeneous granules, and the market's requirements for a higher level of technical support than bulk-blenders are sometimes able to provide.

Security of supply, high quality, and a high level of service are all marketing points that fertilizer makers can latch onto to help build and retain market share.

The competitive strategy of Lonza, for example, has involved an emphasis on service. Lonza is the dominant Swiss supplier of fertilizers but a very small player in the European marketplace as a whole. Why does it stay in? Says Franz Indra, a group leader in the company's agrochemicals unit, the company's fertilizer operations go back nearly to the turn of the century, when it turned its production of calcium cyanide from acetylene to production of fertilizers. "We were one of the first companies with ammonia and nitric acid for ammonium nitrate," he says. The company even had a urea plant, but he adds, "When the petrochemical industry really took off, there we were with a 25 ton-per-day urea plant, and suddenly other plants were 1000 tons per day. We decided to restrict ourselves strictly to the Swiss market—we were not competitive elsewhere."

Considering that Swiss government policy requires that Swiss farmers produce enough food for the country in times of crisis (such as war), the country must use fertilizers. Therefore, Indra says, "We need a Swiss fertilizer industry. Our ammonia is based on hydrogen from naphtha, so therefore we need to have naphtha—But would we, in war? We have an agreement with the Swiss government to keep our water electrolysis plant operational, so we could switch [to electrolytic hydrogen] if needed."

Lonza is helped to be competitive because the government requires importers to keep inventories of 60% of annual sales, a requirement Lonza doesn't have to meet. Additionally, says Indra, although Lonza can't compete on price alone, with the soil and crop analysis system it has devised, "If we give farmers products exactly designed for their plant and soil needs, we have a chance to compete. It is niche marketing. We are optimistic and convinced we can stay in the fertilizer business. We can stay the predominant supplier in Switzerland. We can give a service, selling a philosophy, a system. We won't get rich, but it makes sense for Lonza to stay in the business."

Major producer ICI emphasizes service (such as special analysis programs for farmers) and continual work on process improvement. The company feels it has a winner, for example, with its AMV ammonia process. Two new plants featuring it are due to start up this year in Britain. The process permits smaller plants—probably about half the size of the 500,000 metric ton-per-year standard—with capital costs less than half the typical $175 million or so the bigger ones cost. That makes the process appealing during periods when a company can't justify enormous capital expenditures.

And it is service and attention to business details that BASF looks to for keeping the company successful in the business. "The industry is in a structural crisis," says Tillmann. "In 10 years, we know there will be less fertilizer used [in West Germany] than today, because of cutting back on overproduction of crops, and improved efficiency. There is no replacement for fertilizers; they are a plant food, and you always need that. But you can't sell more. Our obligation is not to produce more, but to produce less, much cheaper—just the opposite from most big-volume chemicals.

"To stay in the business, you have to have good locations, technology, interchange with operations, access to markets, and a need to be in the business. So it's just a question of how much a company wants to stay in, and stay in with up-to-date technology. We're looking at the fertilizer business over [the next] 20 years or more. You must, if you want to continue in the business."

It is also, he adds, a matter of maintaining that partnership with the rest of the agricultural community. "We must help the farmers find the solutions to go on farming." □

High Cost to U.S. Firms of Lax Intellectual Property Laws Detailed

Government aims to use data, which show piracy of patents, trademarks, and copyrights in foreign nations is big problem, to push for greater protection

A report from the International Trade Commission provides new data on the losses U.S. companies face from inadequate protection of their patents, trademarks, and copyrights in foreign countries. The Administration hopes to use this new information in its push for a multinational pact providing stronger intellectual property protection.

Released at the end of February, the ITC report is the result of a year of analysis. U.S. Trade Representative Clayton Yeutter requested the study in January 1987, and ITC held a public hearing in May. According to Yeutter, "The failure of our trading partners to provide effective protection for intellectual property is a severe and growing problem that distorts trade." The bulk of the report is devoted to results from an extensive survey of U.S. companies in a variety of industries on how they have been affected by foreign patent and copyright laws.

The survey questionnaire was mailed to 736 U.S. firms, including the 500 largest firms in the U.S. and others identified as relying heavily on intellectual property protection. ITC received 431 responses, and 269 of these said that intellectual property was of more than nominal importance to their business.

The survey shows that U.S. companies are losing business in several ways because of inadequate intellectual property protection. In some countries, for instance, patent laws explicitly exclude some inventions from being patented. Pharmaceuticals often fall in this category. Patent terms may be far shorter than in developed nations. Compulsory licensing requirements, extremely narrow patent claims, and unrealistic requirements on when a patent must be used are other sources of concern in certain countries.

Yeutter: U.S. will move aggressively

Trademarks face similar problems. Often the scope of what constitutes trademark infringement is far too narrow, and renewal of proof that a trademark is still valuable is difficult. Copyright problems account for some of the biggest losses, much of them in the entertainment industry. ITC reports that many countries have no treaty relationship with the U.S. to make U.S. works eligible for copyright. In addition, some countries only protect certain kinds of works, or have a lot of exceptions to use.

An area important to the chemical industry that is becoming an increasing problem is protection of trade secrets. Many nations seem to have a very short term for keeping data confidential, usually through conditions placed on technology transfer, ITC says. And, there is often no legal protection against the use of trade secret information by third parties because an agreement may only be enforceable between the two original parties.

The upshot of all of this is that ITC estimates U.S. companies lost as much as $61 billion in 1986 because of poor intellectual property protection. Although the number is high, it was not unexpected. Mark

International piracy costs industries billions of dollars

$ Millions, 1986	Lost sales	Lost exports	Lost fees, royalties	Lost employment
Building materials	a	$ 153.4	$ 10.5	478
Chemicals	$123.2	507.3	103.9	1327
Computers & software	a	704.8	235.2	1328
Electronics	292.8	1871.2	15.9	478
Industrial & farm equipment	323.5	126.0	13.0	550
Petroleum refining	a	52.0	38.5	a
Pharmaceuticals	16.2	270.0	231.9	0
Scientific & photographic equipment	1.3	3.1	33.0	a
Textiles & apparel	178.5	26.5	46.5	603

Note: Includes only the companies that responded to the survey. Not all companies in a category answered all questions or provided loss estimates. a Data not provided because it was deemed confidential or inadequate.
Source: International Trade Commission

D. Estes of the ITC General Manufacturers Division and principal author of the report, says that estimates of more than $20 billion had been made for some time. Also, in 1984, ITC issued a report on the impact of counterfeit products imported into the U.S. that concluded that counterfeits cost U.S. manufacturers more than $8 billion annually.

Estes says that data could not be collected regarding specific problems within individual industries, although he says the chemical and pharmaceutical industries are well represented. At least 32 companies in the chemicals and allied products area, and another 20 in pharmaceutical and health care products that sell both in the U.S. and abroad, were involved in the survey. Other chemically related industries were petroleum and refining, rubber products, textiles and wearing apparel, cosmetics and fragrances, and scientific equipment. Some calculation of total aggregate losses for 1986 within these groups was made by ITC. Scientific and photographic equipment makers estimate losses totaling $5.0 billion, pharmaceuticals $1.9 billion, chemicals $1.3 billion, and petroleum refining (including plastics) $1.3 billion.

ITC recognizes that attempts to quantify effects of weak or nonexistent intellectual property laws pose difficulties. Statistics on sales and export losses from violating goods are not collected, for instance. And companies may simply avoid a market if they believe property rights will be ignored. So, ITC says that its data are only good for the companies responding and cannot validly be used statistically to project to all of U.S. industry. Still, the data highlight significant points of concern.

The questionnaire also asked companies to identify and rank the countries that are causing the biggest problems. More than 160 companies responded by naming 67 countries and Hong Kong, including 14 that were thought to have an impact of more than $100 million each. These are, in descending order by estimated losses, Taiwan, Mexico, South Korea, Brazil, China, Canada, India, Japan, Nigeria, Hong Kong, Saudi Arabia, Indonesia, Italy, and Spain. Most of the losses were because of piracy in electronics, computers, recordings, and tapes.

Estes believes that some of these countries are trying to make amends. South Korea and Taiwan have passed tougher intellectual property laws recently, for instance, but it will be a while before it can be determined if these laws are being enforced. The number of complaints about Taiwan has been decreasing recently, Estes says, indicating that some efforts are being made there.

Data from the report will be used by Yeutter to negotiate multilateral agreements for better protection with the offending nations. And if that doesn't work, Yeutter says, the U.S will move "aggressively on a bilateral basis." The subject has been under discussion since early rounds of the international trade talks last year. One incentive for nations to strengthen their laws is to remain on the generalized system of preference with the U.S. GSP, as it is called, is provided to encourage industrial development in developing countries, and, in the case of the U.S., often means being allowed to import products without duty. Loss of GSP could affect a country's exports significantly. According to Estes, good progress is being made on a bilateral agreement in patent and copyright protection. Still, Yeutter says, "It's not just developing countries. There is ample opportunity to improve things among most of the nations of the world."

David Hanson, Washington

Federal Alert—new legislation

This C&EN listing highlights legislation introduced between Feb. 10 and March 3. Senate and House bills are listed under subject areas by bill number, primary sponsor, and committee(s) to which referred.

SENATE

Environment. S. 2060—Dixon (D.-Ill.). Provides $14 million over three years to help communities meet radium standard for drinking water; Environment & Public Works.

S. 2066—Roth (R.-Del.). Bans ocean dumping of municipal sludge by end of 1988, permits five-year waivers for communities currently dumping that have system design and schedule for ending dumping; Environment & Public Works.

S. 2091—Durenberger (R.-Minn.). Gives states authority to design and implement programs to control sources of groundwater contamination under guidance of EPA, requires protection of all groundwater; Environment & Public Works.

S. 2106—Bradley (D.-N.J.). Directs Bureau of Reclamation to assess existing water projects to determine their effect on groundwater quality and quantity, technologies for groundwater recharge; Energy & Natural Resources.

Patents. S. 2111—Hatfield (R.-Ore.). Prohibits patenting of genetically altered or modified animals; Judiciary.

Research. S. 2066—Mitchell (D.-Me.). Provides $29.5 million over five years for creation of 10 multistate, regional marine research centers; Environment & Public Works.

S. 2107—Kassebaum (R.-Kan.). Authorizes USDA to construct plant science and education center at Kansas State University, Manhattan, in accordance with USDA review team's recommendations; Agriculture, Nutrition & Forestry.

Taxes. S. 2092—Durenberger (R.-Minn.). Imposes new taxes on hazardous waste disposal, solid waste disposal, provides for water supply assessment, and excise tax on pesticides sold in lawn/garden market to finance groundwater protection program; Finance.

HOUSE

Environment. H.R. 4074—Hughes (D.-N.J.). Imposes fees on ocean disposal of municipal sludge, prohibits disposal after Dec. 31, 1991; Merchant Marine & Fisheries.

H.R. 4090—Ray (D.-Ga.). Delays for one year the requirement that owners and operators of underground storage tanks have minimum of $1 million insurance coverage per potential occurrence of a leak; Energy & Commerce.

H.R. 4096—Walgren (D.-Pa.). Requires EPA to prescribe standards for all above-ground storage tanks with capacity greater than 4200 gal that contain regulated substances; Energy & Commerce.

Patents. H.R. 4066—Kastenmeier (D.-Wis.). Sets forth basis for determining whether a person has engaged in conduct constituting misuse or illegal extension of a patent; Judiciary.

Testing. H.R. 4048—Gray (D.-Pa.). Prescribes testing employees of refineries, nuclear power plants for use of alcohol, controlled substances; Energy & Commerce.